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The ILLUMINATING ENGINEER

ELECTRICITY · ACETYLENE · OIL · GAS

Edited by LEON GASTER

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OFFICIAL ORGAN OF THE
Illuminating Engineering Society.
(Founded in London 1909.)

Among other articles this number contains :—

Progress in the Natural Lighting of Schools.

The Report of the Committee of the Privy Council on Scientific and Industrial Research.

Illumination in the Navy.

A New Development in High Pressure Gas Lighting.

Street Lighting in War-time.

Welfare Work and what it means.

Other articles include :—

SHADES FOR SUBDUED LIGHTING—ILLUMINATION OF A TENNIS COURT—DECORATIVE LIGHTING IN THE UNITED STATES—REVIEWS OF BOOKS, &c.

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EDITORIAL.

Scientific and Industrial Research.

The Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research has just issued their first Report for the year 1915—1916, a summary of which will be found on pp. 277-280 in the present number.

The work of the Committee has been entered upon in somewhat difficult circumstances. Most of our industries are disturbed by the war, and the energies of skilled workers have been diverted into other directions. The Universities, too, have been largely depleted of their staff and students and, to quote the Report, " those who remain can command neither the leisure nor the detachment of spirit that are essential conditions for original research."

In these circumstances it may be asked " Why try to make a start now? Why not wait until the war is over and normal industrial conditions return? " The Report answers this objection by pointing out that the machinery for research cannot be improvised at a moment's notice. When hostilities cease there will doubtless be a period of adjustment and reconstruction, and our industries will then be in urgent need of guidance and assistance. The Council, therefore, wisely determined to make a commencement, to feel their way steadily but surely for the present, and to construct connections and machinery which will be capable of expansion and wider application in the future.

In many directions, *e.g.*, in connection with metallurgy, pottery, dyestuffs, optical glass, etc., work has already been done. There are naturally

many details of organisation that require study. One interesting point is the respective spheres of action of Universities and highly specialised research institutions. The primary function of the University is admittedly to foster pure scientific research, on the continuity of which industrial progress ultimately depends. Yet it is desirable that Universities should also carry on a certain amount of research of direct industrial application; otherwise they are apt to get out of touch with the industrial world, the process of conversion of pure science into applied science may be checked, and the channel of communication between the scientist and the manufacturer impeded. There are, however, highly technical industrial experiments which require to be carried on continuously for long periods, with the researcher in constant touch with the industry concerned, and in these cases highly specialised research institutions may be needed.

Speaking generally, results of great commercial importance are obtained as a rule after continuous research over a number of years. The conception that research must be made to pay its way within a limited period would be fatal to such work, and this is one reason for advocating that such experiments should be undertaken with the support of a whole industry, which can afford to bear the expenditure and await results, which an individual manufacturer frequently cannot do.

One of the most encouraging facts recorded in the Report is the readiness of professional institutions, Universities, and trade associations approached by the Council to co-operate in the initiation of researches of common benefit. This is a hopeful sign for the future.

An obstacle to the progress of industrial research is the fact that at present few manufacturers have received a scientific training, and men in charge of highly technical and essentially scientific industries are often unable to appreciate the nature of research or the conditions essential to its successful application. In some cases fear of the uncertain future operates as a deterrent. But whatever the future may have in store it seems certain that we can only compete successfully with other countries if our organisation and scientific training are at least equal to theirs. This is particularly true of the important "key-industries."

In this connection it is remarked:—"A healthy condition of such industries can only be secured if, for some time to come, a good deal of attention and money are expended upon convincing the manufacturer that scientific research is a paying proposition."

The immediate problem before us is therefore the exercise of a steady educational influence in favour of scientific and industrial research. This is work that can and should be done *now* as a preliminary to action in the future. We should like to recall one important channel of influence—of which we have every season to believe that the Advisory Council is well aware, although it is not specifically mentioned in the Report—the scientific and technical press. The two Resolutions recently passed at a meeting of the Circle of Scientific Technical and Trade Journalists put on record their willingness to co-operate in this direction, and there can be no doubt that they are in a position to do good service by acting as a channel of information to the respective industries with which they are connected. If, therefore, the Advisory Council will seek the co-operation of such journals and arrange an organised effort in the desired direction the seed of future progress would be sown, and the ground prepared now for the far-reaching measures which will doubtless be taken in the future.

Illumination in the Navy.

The lighting of battleships and the many ingenious applications of light and optics in naval gunnery, searchlights, and other special directions, is a most fascinating field for study. At present it is naturally impossible to discuss in detail such applications in the British Navy, although we hope that after the war it will be possible to say more on this subject.

Meantime we notice that in the United States naval matters are being keenly discussed, especially in their engineering aspects, an instance being the paper by Lieut. C. S. McDowell on " Illumination in the Navy," which is referred to on pp. 281—283 in this issue. The " battle " and " lighting " circuits on American warships, he states, are supplemented by a special emergency circuit, and it is evident that the entire interruption of the lighting of a ship in action would often be a serious matter. Every effort is therefore made for the duplication and protection of circuits. It is interesting to note that as far back as 1912 the Navy Department initiated a special investigation into the conditions of illumination on warships, as a result of which a table of the illumination-intensities in foot-candles in various departments was drawn up. In view of the fact that life on board shiy takes place so largely under cover, where there is little, if any, access of daylight, it seems very desirable to fix a reasonable standard for the artificial illumination.

The design and use of searchlights, and the application of light for signalling purposes are also discussed in Lieut. McDowell's paper. Experiments on cooled electrodes, run at a very high current density, have now been made in the United States, and it is stated that the candlepower and concentration of beam of the Beck searchlight have been equalled and even surpassed. Good progress has also been made with projectors of moderate power, using concentrated incandescent filaments. The highly debateable question of the effect of colour of the beam is also discussed. There is a general impression that the use of gold-mirrors, or yellow transparent diaphragms, in order to exclude the blue and violet light, is advantageous, but the question cannot be regarded as finally settled.

Lieut. McDowell's paper suggests that the United States Navy is keenly alert to the necessity of being kept informed of the latest advances in illumination. For some time a movement has been in progress for organising the scientific and engineering resources of the country for naval work. We notice, for example, an address by Mr. Frank P. Sprague, a member of the Naval Consulting Board of the United States on " Naval Preparedness and the Civilian Engineer."*

Mr. Sprague gives some interesting particulars of the work of the Naval Consulting Board, which was formed by the appointment of two representatives by each of the leading scientific and engineering bodies in that country. The Board has already recommended the erection and equipment of a Naval Research Laboratory and Experimental Station, at a cost of about one million pounds, with an annual expenditure on experimental work of about half a million pounds.

It is significant that one of the first steps taken by the United States in the direction of " Preparedness " should be in the direction of organising scientific research. No doubt this matter is receiving attention from the Authorities in this country.

* Jour. of the Western Society of Engineers, Feb. 1916.

Hours of Labour.

It will be recalled that in a recent Memorandum issued by the Committee of the Ministry of Munitions (No. 5) some general recommendations were made as to the limitation of hours of work. Since that time detailed inquiries into various kinds of work have been made, and a striking Report on the subject by Dr. H. M. Vernon, whose services were secured by the Medical Research Committee, has just been issued.

It was previously suggested that the average weekly hours of labour, including overtime, should not exceed 65—67 for men, and 60 hours for women. Naturally such figures may require a little modification according to the kind of work done, and in Dr. Vernon's researches a broad distinction has been drawn between heavy, moderately heavy, and light labour.

The results confirm the previous recommendations in a most remarkable manner. Indeed, in many cases the hours might with benefit apparently be reduced below the figures quoted above. There is clear indication of the benefit of a short holiday. By tabulating the hours of work, hourly output, and the produce of these two quantities over a period of several months, it was often possible to establish that longer hours meant, in the long run, a smaller output. Thus in the case of 100 women turning fuse-bodies, it was shown that a diminution in working hours from 68·2 to 59·7 hours per week was coincident with a gain in total output of 8 per cent. In the case of a group of youths of 14—17 years of age, also working on fuse-bodies, an even more remarkable result is recorded. It was found that after the Christmas holiday the hourly output rose to 16 per cent. greater than in the pre-Christmas period, in spite of slightly longer hours, whilst it was no less than 42 per cent. greater in the eleven subsequent weeks, when the weekly hours of labour were reduced from 70·3 to 57·0; in consequence the total output attained a value 19 per cent. in excess of that before Christmas. These boys were evidently overworked by the long hours, and the reduction from 12 to 8 hours had an immediate beneficial influence.

Such cases prove the desirability of a careful scientific study of hours of labour in the interests of production, quite apart from their influence on the future health and well being of workers. It is to be noted that, in view of the present emergency the hours suggested are the *maximum* hours of work from the point of view of production; they are probably only possible for the fittest of the workers, and much in advance of the number of hours which would be considered best in time of peace.

Another point that deserves fuller study is the effect of a short recuperatory pause during the day. If workers are left to themselves they take rests at irregular and often unsuitable times. It would be much better to arrange for regular pauses at intervals, which will naturally vary with the class of work, and can only be determined by experiment. In many works there is a needless loss of time in starting and ceasing work, and if this could be avoided the time thus gained might well be utilised for rest purposes at convenient intervals.

In this connection the proper heating and ventilation of a factory is a most important matter. In order to raise the temperature of a large room to a comfortable value, the heating arrangements should be put into operation for a suitable period before the actual start of work. Otherwise time will inevitably be lost because the operators are physically incapable of giving the full output during the initial hours of work.

LEON GASTER.

PROGRESS IN NATURAL SCHOOL LIGHTING.

IN a recent number of *School Hygiene*,* Mr. G. H. Widdows, F.R.I.B.A., gives an account of a most interesting "open air" school at North Wingfield (Derbyshire), the building of which was specially designed by him to meet the requirements of adequate ventilation, heating and lighting. The school has been running for nearly eighteen months. Through the courtesy of the Derbyshire Education Committee it was inspected when in course of erection by the Joint Committee of the Illuminating Engineering Society appointed in 1913 to consider Natural Lighting in Schools. Mr. Widdows expresses appreciation of the work of the Illuminating Engineering Society on this complex subject—work which, but for the interruption caused by the outbreak of war shortly after the issue of the Committee's report, would doubtless have received much more attention.

The arrangements at the North Wingfield School in respect of lighting, heating and ventilation are, in some respects, unique. In the design of schools ventilation is usually achieved through the windows and there must therefore be a compromise between the conditions respectively most ideal for lighting and ventilation. Mr. Widdows has avoided this difficulty by arranging for ventilation through doors, which are arranged to run the whole length of both sides of the classroom. The doors can be opened as a whole, and the top half of the door can also be dropped or only lowered a few inches. This utilisation of the upper door-area is useful on cold days as it provides for access of fresh air into the upper part of the room without causing a cold draught round the feet of the children. Moreover the fact of having doors along both sides of the room makes it possible to provide ventilation from either side, according to the direction of the wind.

It has generally been assumed in school-lighting that access of light must be provided mainly by windows in the vertical walls. As a rule the construction of the building makes this obligatory but it is evident that when schools can be specially designed with a single story an inclined sky-light may be more efficient. Mr. Widdows has therefore made use of a continuous sky-light inclined at 60 degrees with the horizontal on the north side of the rooms. This gives abundant and very even illumination, the "north light" being recognised as the best form of daylight illumination for studios and other cases where a steady illumination is wanted. Some dormers on the south side have also been provided as it was thought desirable to allow access of sunlight into the rooms from time to time. These windows can be screened with curtains in cases where the cross-shadows cast by them are apt to be inconvenient. Even with the curtains drawn the least-lighted part of the room receives as much as 5 per cent. of the outside unrestricted illumination—a very high value when it is remembered that schoolrooms where the minimum illumination is not less than one per cent. of the outdoor illumination are usually considered to be well-lighted.

The heating of the school is also arranged on a novel plan. A steam boiler working at 3 lb. pressure is provided. The floors are made of concrete with grid-iron trenches into which the steam pipes are taken. Over the trenches are laid stone slabs and the heat rises from the floor and is thus very evenly communicated throughout the room. The system is said to be exceptionally efficient. The only other heating in the rooms is afforded by a steam pipe running round the rooms immediately under the level of the skylights. This serves to prevent a down draught. With this exception the piping is entirely out of sight but can easily be reached at any time by merely lifting the stone slabs;

* May, 1916.

the absence of unsightly masses of pipes round the room is a distinct advantage.

In order to illustrate the uniformity of the distribution of heat it is mentioned that the temperatures one foot and six feet above the floor were respectively 59° and 57°. The floor-temperature need not exceed 75°, and this should not be trying to people with normal feet.

Mr. Widdows was no doubt fortunate in the conditions under which this design was carried out, and it may naturally be difficult to secure equally satisfactory arrangements in large many-storied town schools in congested areas. The experiment is, however, well worth notice by those concerned with country school design. Other schools of the same type were to have been erected in Derbyshire, but the work has been interrupted by the war. Let us hope, with Mr. Widdows, that "all the efforts which have been put forth to improve the lot of the school child will not be brought to nought, and that the education and housing of the children will not be the first thing to suffer when the much-longed-for peace comes."

TWO NOVEL SAFETY-DEVICES.

A RECENT issue of *Popular Mechanics* describes two novel safety-devices being employed in America.

The first of these is a periscope of large size which is mounted in the signal cabin near a somewhat complicated piece of track on the Elevated Railway of Chicago. This enables the operator to observe the motions of adjacent trains when they would otherwise be out of the direct range of vision.

The second device involves the use of a luminous hand, which is compased of translucent material and illuminated by a small glow lamp placed within it. This is used by motorists at night, being thrust out to right or left to indicate a turn, just as the driver ordinarily uses his hand in the daytime.

TESTS OF STREET ILLUMINATION.

IN a recent paper before the Illuminating Engineering Society in the United States, Mr. P. S. Millar draws a distinction between tests of the effectiveness of the lighting, and tests to determine compliance with a legal contract. The latter should be based mainly on the specification of certain lamps, arranged in a particular manner and operated under prescribed conditions. If a test of candle-power is enforced this should relate to the total flux of light from the lamps used. This is most conveniently tested with an Ulbricht Globe in the laboratory, but Mr. Millar also shows an illustration of such a test being carried out in the street. The Globe and accessories are mounted on a motor-trolley. This is brought immediately under the lamp to be examined and the lamp is lowered through the aperture at the top of the globe.

A description is also given of a very interesting series of experiments carried out in a length of street in Philadelphia. Besides tests of the total light-flux of each lamp, the horizontal illumination at street level, the vertical illumination 4 ft. above the street, and the surface-brightness of the street were determined. In order to determine the "revealing power" of the illumination small discs and cylinders, painted the same tint as the street-surface, were distributed along the road-way and foot-passengers and people riding were asked to pick them out. Results of this test suggest that absolutely even illumination along the street is not essential, since variations in brightness are often useful in enabling the "silhouettes" of obstructions to be recognised. On the other hand great extremes of illumination, such as are met with on country roads, are naturally unsatisfactory.

COMMITTEE OF THE PRIVY COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH.

REPORT OF THE ADVISORY COUNCIL FOR THE YEAR 1915—1916.

The Advisory Council, which was constituted by Order of Council dated July 28th, 1915, has now issued a Report for the past year, summarising the most important steps already taken for promoting scientific and industrial research.

In referring to previous Governmental action in this direction a tribute is paid to the work of the National Physical Laboratory. "The Laboratory," it is pointed out, "has done and is doing most valuable work for our industries and for the Government, and it might have done much more had it been endowed with anything like the annual subvention of nearly £100,000 which the American Bureau of Standards receives for development and maintenance from the United States Government." But experience has shown that no single institution, however great or distinguished, can expect to do more than a part of all that our vast industries require.

The foundation in 1907, under a Royal Charter, of the Imperial College of Science and Technology was also a most important step. Within the last few years science and engineering have also received more encouragement at Oxford and Cambridge, and there have been important developments at many of the northern and provincial universities.

The flotation of the great company, with a possible ordinary share capital of £3,000,000 (against which the Treasury undertook to make advances up to a limit of £1,500,000 secured by debentures) for the manufacture of dyestuffs and similar chemical materials required by the textiles industries of the country, is perhaps one of the most important ventures since the outbreak of war.

AIMS AND OBJECTS.

In explaining the steps leading to the action so far taken for the promotion of scientific and industrial research, the Report emphasises the urgency of the problem and its future significance.

"The brains, even the very processes, that to-day are necessary for the output of munitions were yesterday needed, and will be needed again to-morrow, for the arts of peace. . . ." This is the central fact which justified the establishment of the new machinery in the midst of a struggle that is absorbing the whole energies of the nation in a way no previous war has done. It has been questioned whether it would not have been wiser to avoid the inevitable difficulties resulting from the war by postponing action until peace was restored. Mr. Henderson foresaw this criticism when he remarked that "we cannot hope to improvise an effective system at the moment when hostilities cease, and unless during the present period we are able to make a substantial advance we shall certainly be unable to do what is necessary in the equally difficult period of reconstruction which will follow the war."

"PURE" AND "APPLIED" SCIENCE.

The Council, however, decided to give science in its applications to industry precedence over "pure science." While they are under no misapprehension as to the relations between pure and applied science and recognise that what is commonly called "applied science" is merely the application of pure science to particular classes of problems, they point out that in this matter they have to deal with the point of view of the practical business world. "The average manufacturer is impressed with the importance of quick returns; he cannot afford to

wait. The managing director of one manufacturing firm recently told us that he had no interest in research which did not produce results within a year. If science can help him to overcome the difficulties that cross his path from day to day he welcomes her. He wants a handy servant, not a partner with ideas of his own."

No doubt there are firms which take a more enlightened view, but the scepticism of the average business man is natural. The difficulties that present themselves to manufacturers and merchants seldom afford an indication of the true nature of the problems to be solved. They are generally secondary in their nature, and a direct attack on them is likely to be as empirical as the symptomatic treatment of disease. Thus such quick-result inquiries as the manufacturer is induced to make are very likely to be fruitless and to reduce his enthusiasm for science still further.

Another consideration that inclined the Council towards the encouragement of researches having a directly practical application was that the universities, the natural homes of research in pure science, have been so depleted of students and teachers by the war that they are barely able to continue their routine work and can command neither the leisure nor the detachment of spirit that are essential conditions for original research.

Standing Committees.

They have, therefore, also tried to work through the agency of Standing Committees dealing with such subjects as metallurgy, engineering, mining, &c., on which the great professional institutions concerned, working in conjunction with the Home Office and the Board of Trade, are adequately represented. Other Standing Committees in contemplation include those on Fuel, Rubber, and the Chemistry of Cotton and Paper, and a Standing Committee for Textiles with special sections for Cotton, Wool, and Silk.

In addition, advantage has been taken of the research facilities of many educational institutions and universities, and of the leading Trade Associations and Professional Institutions and Societies throughout the country, including the Institute of Chemistry, the Society of Chemical Industry, the Society of Public Analysts, the Society of Dyers and Colourists, the Royal Institute of British Architects, the Faraday Society, the British Electrical and Allied Manufacturers' Association, the Staffordshire Pottery Association, the Silk Association, the Federation of Master Printers, &c.

A compilation of a Register of the Researches actually being conducted by Universities and Institutions throughout the country has been undertaken, and a careful survey is also to be made of the facilities for research throughout the country. It is hoped that the Register will enable workers on specific subjects to be found when new proposals for experiments are brought forward. Speaking generally, the great need is for Organisation and Co-operation. It is gratifying to note the statement of the Committee that:—

"In the numerous conferences we have had with representatives of different industries, we have been impressed by the spirit of co-operation which is growing up and the willingness to accept our suggestions for the initiation of research for the benefit of the trade as a whole."

Examples of Emergency Research.

The emergencies arising on the outbreak of war have in themselves induced many manufacturers to act. Thus the great steel manufacturers were in grave danger from the possible exhaustion of the supply of chemical glass necessary for the testing of their materials. Consulting chemists were in the same difficulty. The work of the Institute of Chemistry has done much to remedy this deficiency. Similarly, pottery manufacturers were in lack of the Segar cones necessary as a guide to the firing of their china and earthenware. Dr. Meldola, the Principal of the Stoke Pottery School, stepped into the breach, and was soon able to manufacture sufficient cones for the whole pottery trade. This and other facts led eventually to the erection of special research laboratories and workshops in connection with the Stoke School of Pottery, for which a special grant was given by the Board of Education, and

where experiments on the manufacture of hard porcelain with British materials are being conducted.

Co-operation of Trade Associations.

There has also been a significant movement towards forming powerful Trade Associations, resembling those prevailing abroad, and in several cases these Associations are already taking steps to foster research in their respective industries. It has been pointed out that a manufacturer who requires information is under a drawback in being obliged to consult an individual expert and to bear personally the whole burden of the fees involved. There is need for the establishment of a great central institute, where joint researches can be conducted for the benefit of all the members of an industry. Equally pressing is the problem of devising facilities for finance similar to those provided abroad by the industrial banks. The Board of Trade has appointed a Committee, under the chairmanship of Lord Faringdon, "to consider the best means of meeting the needs of British firms after the war as regards national financial facilities for trade, particularly with reference to the financing of large overseas contracts, and to prepare a detailed scheme for the purpose."

"Key-Industries" and State Assistance.

The fear has often been expressed that there is no security that, after new ventures have been undertaken, manufacturers will not be left at the mercy of the highly-organised competition of foreign countries after the war. There appears to be no single specific remedy. Organisation can only be met by counter-organisation, and the solution of the difficulty must lie in co-operation of an industry as a whole, in place of the independent efforts of manufacturers acting as individual units. On the other hand, in the case of certain "key-industries," on which many others are dependent, provision may be taken for some State assistance. Apart from their industrial importance, these highly scientific trades deserve recognition in view of their educational and intellectual value, and their influence in raising the status of the industrial life of the nation.

In any case a healthy condition of such industries can only be secured if, for some time to come, a good deal of attention and money are expended upon convincing the manufacturing world that scientific research is a paying proposition. In this connection an interesting analysis is made of the conditions in the United States, and the respective parts played by Universities and manufacturing concerns in promoting research. As examples the highly developed arrangements of the Eastman Kodak Co. and the National Electrical Lamp Association are quoted. It is interesting to note the contribution of the Prussian Government to the optical work of the firm of Schott of Jena is, apparently, the only instance of *direct* assistance derived from the German Government. On the other hand, the German States spend lavishly on their education, particularly upon Universities, Technical High Schools, and Research Laboratories, from which the industries as a whole benefit.

Respective Operations of Universities and Research Institutes.

The view has been expressed that Universities are not well adapted for long-sustained researches requiring considerable industrial equipment, and the allocation of their activities to "pure science" of benefit to humanity as a whole, and "applied science," in connection with specific industries, requires careful study. There is doubtless a field for special research institutes, such as the Stoke Pottery School and the Research Institute for Glass at the University of Sheffield, and the plan adopted in America of granting fellowships for researches on specific subjects, with the support of the industry concerned therein, also deserves mention.

Conclusion.

After referring to the measures for developing industrial research now being taken in various parts of the Empire, notably in Australia, the Report offers several tentative conclusions. Among the conditions essential to the realisation of the aims they have in view are: (1) A

largely increased supply of competent researchers; (2) a hearty spirit of co-operation among all concerned, men of science, men of business, working men, professional and scientific societies, Universities and Technical Colleges, Local Authorities, and Government Departments.

Progress in the immediate future must necessarily be slow. It appears certain that the number of trained research workers who will be available at the end of the war will not suffice for the prospective demand.

No less important than the co-operation of men of science and manufacturers is the co-operation of the workers themselves. It is significant, if singular, that the making of weapons of destruction for the war has afforded unique opportunities of humanising industry. The problems involved in munition work have given a great impetus to the study of the conditions of labour and to the Welfare movement. More cordial relations between employer and employee will do much to smooth the path of industrial reorganisation.

ILLUMINATING ENGINEERING SOCIETY (U.S.A.).

Tenth Annual Convention.

We recently published a summary of the papers to be read at the Tenth Annual Convention of the Illuminating Engineering Society in the United States, to take place in Philadelphia during September 18th—20th.* We are now informed that the Presidential Address will this year be delivered by Dr. Chas. P. Steinmetz, and that reports of the Committees on Progress and Nomenclature and Standards will be presented.

The special course of twenty lectures on Illuminating Engineering is to be given immediately after the Congress at the University of Pennsylvania, on September 21st—28th. We notice that a reprint of all the lectures will be issued, the cost of which is included in the tuition fee of 25 dollars.

UNEVEN LIGHTING AND ARCHITECTURAL EFFECT.

Mr. Morgan Brooks, in a paper before the Illuminating Engineering Society (U.S.A.), remarks that non-uniform illumination often produces a special architectural effect. For example, if the stage in a concert room receives a strong illumination, the front of the auditorium somewhat less light, and the back portion less still, the effect is to diminish the apparent length of the hall—often a useful result in long and narrow rooms, especially if the back rows of seats are empty.

* *Illum. Eng.*, July 1916, p. 222.

GAS RESEARCH FELLOWSHIPS AT ILLINOIS (U.S.A.).

According to the *Gas Age*, the Illinois Gas Association has arranged with the University of Illinois for the establishment of a research fellowship on gas engineering and is providing 500 dollars for a period of four years for this purpose.

The officers of the various companies represented in this Association will each nominate one or more members of their staff for the fellowship. The list of names thus prepared will be submitted to the Director of the Engineering Experiment Station of the University who will select the successful candidate.

The results of any researches carried out will be the property of the University for dissemination to the public through such channels as it may select.

ILLUMINATION IN THE NAVY.*

By LIEUT. C. S. McDOWELL, U.S.N.

ILLUMINATION OF SPACES ON SHIPBOARD.

THIS term includes the lighting of the living spaces for officers and crew, machinery spaces, firerooms, turrets and gun compartments, shell rooms, powder magazines, sick bays, coal bunkers, upper deck spaces, gangways, &c.

The lighting on board ship meets special requirements. In some cases lights serve several distinct uses. Fittings must be designed to meet special conditions imposed by low head room, liability to damage through shock from gunfire, and the necessity to maintain the integrity of water-tight compartments. In 1912 the Navy Department started a special investigation into these matters, eventually drawing up a table of values for the intensity required for various purposes, as summarised in Table I. It is interesting to notice that as a result of the low ceilings and white wall surfaces semi-indirect and indirect devices are

ILLUMINATION REQUIRED FOR VARIOUS PURPOSES ON BOARD BATTLESHIPS.

FOOT-CANDLE INTENSITIES.

Ammunition passages	2.0	Galleys	2.0
Armory, plus metal reflectors at bench	2.0	Handling room	2.5
Battle dressing station	2.0	Interior com. room	2.0
Battle dressing stores	2.0	Ice machine room	2.0
Bakery	2.0	Isolation room	2.0
Bath room	2.0	Issuing and store room	2.0
Barber shop	2.5	Laundry	1.5
Boiler rooms, plus 250-watt units	1.5	Lamp room	1.5
Butcher shop	1.5	Machine shop (general)	1.0
Band room	1.0	Magazine	1.5
Blower room (special)	—	Mess rooms (officers')	2.5
Blower space	1.0	Mess attendants' wash room	2.0
Cabins	3.0	Offices	4.0
Carpenter shop	3.0	Operating table	15.0 to 25.0
Chart house	5.0	Paint room	1.5
Chief P.O. quarters (berthing)	1.5	Paint mixing room	1.5
Chief P.O. quarters (messing)	2.0	Pantries	2.0
Crew's space	1.5	Printing office	4.0
Conning Tower (officers')	1.5	Pump room	1.5
Crew's wash room	2.0	Post office	4.0
Crew's water closets	2.0	Prison (special)	—
Conning tower (special)	—	Reception room	3.0
Chain locker	1.5	Surgeon's examining room	2.0
Coal bunkers	0.7	State rooms	3.0
Coaling ship (special)	—	Sub	4.0
Dispensary	3.0	Sub central	4.0
Desk	4.0	Shell room	2.0
Distribution room	2.0	Store rooms (fixed stores)	0.7
Dynamo room, plus 250-watt units	1.5	Store room (stock for issue)	1.0
Decks, outside (special)	—	Sick bay	2.0
Engine room, plus 250-watt units (treated special)	1.5	Storage battery chg. sta.	2.0
Evaporator room	1.5	Ship's store	2.0
Firemen's wash room	2.0	Torpedo room	2.0
Foundry	3.0	Turrets (special)	—
Fire room (treated special)	—	Water closets	1.0
Fuel oil relay tank room	2.0	Wireless room	3.5
General condiment and issuing room	2.0	Workshop (additional special illumination to be provided at machines)	1.5
General mess pantry	2.0	Windlass space	1.5

* Abstract of Paper read at a meeting of the Illuminating Engineering Society, U.S.A. (*Trans. Am. Ill. Eng. Soc., U.S.A.*, July, 1916.)

largely used. Carbon filament lamps are employed for portable lamps, with a view to diminishing danger of breakage; otherwise tungsten lamps of 25, 40, 60 and 250 watts are chiefly used. 250-watt units are installed in the engine rooms.

The standard voltage until the last two years was 120 volts; on the newer battleships, however, 240-volt generators and a three-wire system are installed, the lighting circuits from the distributing boards being thus still 120 volts.

On board battleships there are two regular lighting circuits known as "battle" and "lighting" respectively. The battle circuit includes all circuits below the protective deck, circuits to guns, searchlights, signalling apparatus, running lights and in general all the lights which would be absolutely necessary in action. Lighting circuits include those which may be dispensed with in action. In addition to the above there is installed an auxiliary or emergency lighting circuit fed with 20 volts from storage batteries.

Searchlights.

The chief essential in the modern searchlight is to obtain a source of minimum area and maximum brightness. For many years the arcs used have remained substantially the same, but quite recently great improvements have been made by using a higher current density in the positive electrode, means being provided to carry off the heat; and at the same time using a smaller negative carbon, so as to obstruct less light. In the latest searchlights the diameter of the positive carbon has been decreased to half its former value, and at the same time the current has been increased so that, with a crater of $\frac{5}{8}$ in. diameter, a maximum luminous intensity of 90,000 candles throughout an angle of approximately 70 degrees is obtained. Moreover, the size of the crater is so diminished that the area of the beam is reduced to one fourth of that previously obtained; as the candlepower has also been increased from 50,000 to 90,000 the actual illumination on the target is more than six times the amount formerly attained.

The composition of the positive carbon is very important, a core of white flaming material being used. The negative carbon is set at an angle to the positive with a view to confining the luminous flame within the crater. This effect seems to require a certain minimum current of approximately 90 amperes. The standard diameter for mirrors is 36 in. The negative is only $\frac{7}{16}$ in. diameter, being also about half that used with the older type of arc.

In the discussion, Mr. Sperry and Mr. W. Bassett Jones referred to the Beck searchlight. Although the work in America has proceeded on somewhat different lines equally good results have been obtained. It was mentioned that although the carbons were approximately the same size as those used in the Beck searchlight the crater-area is about 30 per cent. less, thus giving a still smaller angle of dispersion.

Incandescent Searchlight Units.

Tests have also been carried out with gas-filled incandescent lamps having concentrated filaments. This type will probably be satisfactory for navigation purposes where it is not necessary to illuminate objects at great distances.

As such filaments, being approximately "point lights," give a more or less uniform distribution of light, short focus mirrors embracing as large as possible a proportion of the luminous flux, are desirable.

In the discussion L. C. Porter remarks that the various types of "flood-light" projectors now available should be very suitable for navy work, around docks and piers, and especially for loading and coaling. Focus-type incandescent units for searchlights ranging from 1 to 5,000 candlepower are now made. There is, for example, one unit comprising a single lamp fed from a dry battery which will throw a beam with an effective range of 200—300 feet.

Effect of Colour of the Beam.

The question of the colour of the projected light is also interesting. From one standpoint the accentuation of the green and blue component in the arc light is advantageous, namely, that on account

of the low illumination of distant objects, the sensitiveness of the eye to this region of the spectrum is exceptionally high; moreover, objects illuminated are frequently of a bluish-grey colour. On the other hand the longer wavelengths are less absorbed in a mist or fog. In some experiments conducted with an artificial fog it was found that, when using silvered glass mirrors the illumination of an object 50 ft. distant from the light through the fog was but 21 per cent. of the illumination under normal conditions; but by using a gold plated mirror the illumination under the same conditions was 60 per cent. of that obtained under normal conditions.

In addition, owing to the chromatic aberration of the eye the visual acuity with a gold-backed mirror, is, for the same illumination, greater than with a silver-backed mirror, and distant objects "stand out" in greater detail. The gold-backed mirror has been extensively used by some countries, but it is doubtful whether its use is advantageous with the latest type of arc which contains a strong blue and violet element. In the discussion Mr. L. C. Porter remarked that tests he had made with an amber front glass showed that in these circumstances signals near to the searchlight could be somewhat more readily picked up, owing to the diminution in glare. But he did not find that objects could be picked up at a greater distance with an amber beam than with a clear beam of equal intensity.

Evidently there is still considerable difference of opinion on this subject.

Signalling by means of Light.

Distant signalling is made mainly by means of the following systems:—Ardois; night semaphore; blinker light; searchlight.

The ardois consists of four lamps mounted in a vertical line, as high as possible in the rigging. Each lamp contains a red and a white lamp, and the lights are controlled by a keyboard similar to that used on a typewriter. The Morse code is used, red lamps indicating a dot and white ones a dash. The system is very easy to use as the keys are all lettered and numbered, but it can only be used for relatively short distances.

In the semaphore system use is made of a machine with two swinging arms, which can be manipulated to represent the letters of the alphabet by their relative positions. These arms can be equipped with tungsten lamps and reflectors so as to be readily visible by night.

The blinker system employs a pulsating light source, such as an incandescent lamp with tapping key, controlled from a telegraph board, rapid signalling being transmitted by the intervals of lighting up and extinction of this lamp. This is only available for night work.

The use of the searchlight is well adapted for signalling over long distances, even as great a distance as 50 miles having been covered. It has, however, given place to some extent to wireless telegraphy. The light from searchlights can be alternately made visible and extinguished by means of electrically operated Venetian shutters. Other methods of producing the fluctuation in light without striking the arc have been devised. For example, if the arc is struck with a relatively high frequency and high voltage it can be maintained at a low voltage. By shunting the arc with a resistance the current in the main line may be maintained constant and the current across the arc reduced to about one-tenth of its normal value. The variation in light thus produced gives the same effect as if the arc were actually shut on and off.

Searchlight-signals can be conveyed in the daytime. Even with small searchlights as much as eight miles have been covered by day, the light being directed straight at the observer on the same principle as a heliograph. For long distance night work the beam is usually directed on some dark cloud in the direction of the receiving ship.

There are also many other special problems on board ship, such as the illumination of compass cards. This must be so arranged that the markings of the compass are quite distinct but no glare is present. Another example of special uses of light is the illumination of the cross wires of telescopic gun sights.

STREET LIGHTING PROBLEMS IN WAR TIME.

A recent issue of *Municipal Engineering and The Sanitary Record* comments on the difficulties which Corporations and District Councils are experiencing in satisfying simultaneously the requirements of various authorities in adjusting the public lighting in war time.

As the question is one of considerable interest at the present time, we are reproducing some of the comments of our contemporary in the article referred to. The various points raised deserve consideration, and it would be desirable for any apparent misunderstanding to be cleared up.

It is stated that:—

"By a series of somewhat erratic and unpractical requirements, the lighting authorities have been induced in many cases to continue the consumption of gas and electricity in the public lamps, the illumination being wasted by restricting it to the interior of such lamps by coating over the glass, so that no rays shall be reflected on the surface of the street. The demands of the Government authorities are, of course, based on the Defence of the Realm Regulations, 1914, and an Order of the Secretary of State made thereunder, but it is probable that some confusion has arisen through the different powers which affect Metropolitan Borough Councils, as compared with Local Authorities outside the Metropolis. For whilst such Borough Councils are compelled under Sec. 130 of the Metropolis Management Act, 1855, to cause the streets within their districts to be well and sufficiently lighted, there is no such duty cast upon Councils outside the Metropolis. In the district immediately outside the Metropolitan Boroughs there is a considerable area containing numerous Boroughs and District Councils, which are under the jurisdiction of the Metropolitan Police, such area being legally defined as the Metropolitan Police Area. Many of such Councils, we have observed, have recognised the futility of the expenditure of wasting an illuminant for confinement within obscured glass, and have approached the police authorities for their assent to discontinue the practice. Such assent is invariably postponed, and many of the Councils have submissively continued the unjustified expenditure. Some Authorities, on the other hand, discontinued public lighting except at important street intersections six months ago, and have saved the ratepayers very considerable sums of money. If the requirement of the Government department was essential for the safety of the inhabitants of any district, no demur could be raised to it. In the Metropolis, where the street traffic is, of course, heavy, and where the authorities are bound to execute public lighting, it is requisite for the safety of pedestrians. But in extra-Metropolitan districts public lighting is really inimical to public safety, for it attracts prowling Zeppelins. When we come to examine the legal aspect of the question, it is found, as stated by our contemporary, the *Justice of the Peace*, in its issue of September 9th (page 171), that the claim of the police, empowering their chief officer to require a District Council to light such of the street lamps as he directs, is unfounded. They point out that Regulation 11 of the Defence of the Realm (Consolidation) Regulations, 1914, empowers the Secretary of State by order to direct that lights shall be extinguished or obscured. But the regulation does not empower him in any other respect to require lights to be provided or public lamps to be kept in use. The Order of July 22nd, 1916, made under the regulation, and under which the police claim to act, must be read with the regulation, and could not extend the power conferred by the regulation, and this legal view of the case will doubtless be helpful to many Local Authorities throughout the kingdom."

LIGHTING REGULATIONS IN GERMANY.

In this country we have now had time to become accustomed to the lighting restrictions. The attempts that have been made to define the permissible brightness of lights in this country have been the subject of some comment, and although the problem is admittedly not an easy one, lighting experts cannot help being struck by the somewhat vague and indefinite nature of many of the terms used.

It is therefore interesting to notice that similar precautions are now being taken in the naval ports of Germany, and to compare the wording of their regulations with our own. According to a recent issue of the *Evening Standard*, the following announcement ordering more stringent precautions has appeared in the *Wilhelmshaven Zeitung*:—

"No more lights are to be shown in streets, yards, gardens, private or public buildings. Curtains and blinds which have hitherto been considered a satisfactory precaution are now regarded as insufficient. Illuminated signs are prohibited, and all the special light-permits are withdrawn. Shop-windows are to show no more than just sufficient light to enable customers to distinguish the goods.

"Rehearsals of the arrangements for the safety of the public will be held nightly until further notice."

Certainly some of these requirements —especially that dealing with the highly problematical illumination required to "enable customers to distinguish the goods"—are not particularly explicit.

FESTIVAL LIGHTING IN THE UNITED STATES.

In the *Journal of Electricity, Power and Gas* an account is given of some interesting spectacular lighting—a form of lighting with which we in this country have necessarily become unfamiliar since the outbreak of war.

On the occasion of the Portland Rose Festival at Portland, Oregon, special electric lighting devices played a prominent part. These included various symbolic signs associated with the history of the town, such as 30 ft. white columns, bearing in a niche a figure of Sacajawea pointing the way to the festival centre, and decorated with paintings "presenting the scenic wonders of Oregon." These columns were illuminated from head to foot with concealed "flood-lighting." The chief feature was the erection of a "rose-fountain," where, by a combination of trailing green shoots, flowing water and winking rose-coloured electric lights, a fountain of roses bubbling over in a foaming spray was simulated. It is stated that the individual efforts of householders were kept in harmony with the civic decorations so as to aim at a co-operative display.

Whatever views one may hold as to the artistic value of such spectacular lighting, it cannot be denied that in these American cities there is often a touch of imagination about the decorations, which has not always been a feature of attempts at festive lighting over here.

What, one wonders, will be the nature of the illuminations when peace is at last declared? Will there be an attempt at a co-operative effort worthy of the occasion? Or will we once more fall back on the old studded lights, crowns and similar time-honoured devices which have done service in times gone by?

THE CONTRACTOR AND THE ARCHITECT.

The architect and the general contractor have in the past usually ignored the electrical contractor until the time arrived for the latter to bid on the work, and then the amount of his bid was the only feature of interest about him. This has been partly due to the fact that the average electrical contractor was only concerned in the mechanical end of the installation work and was not prepared to offer any advice or suggestions as to plans and specifications. To-day, however, many contractors are giving close study and attention to the requirements of their work, and architects and engineers might receive valuable aid in planning the electrical equipment by taking the electrical contractor into their confidence.—*Electrical Review and Western Electrician*, August 5th, 1916.

A NEW DEVELOPMENT IN HIGH PRESSURE GAS LIGHTING.

In the course of the Presidential Address delivered by Mr. Alexander Masterton, of Edinburgh, before the North British Association of Gas Managers on September 2nd, some particulars were given of a new development in high pressure gas lighting, of special utility in factories where there is much dust or fluff in the air.

This new form of lighting is installed in the works of the North British Rubber Company, which for many years was lighted on the low pressure system. It was recently decided to try to improve matters by applying high pressure lighting, with a view to possible application to extensions of premises as well as in the old works. Accordingly a high pressure plant with compressors in duplicate driven by electric motors was fitted up, and 80 candlepower lamps, consuming from $1\frac{1}{2}$—$1\frac{3}{4}$ cub. ft. per hour, introduced. It was desired to diminish the amount of gas used, as compared with the low pressure lighting, by 40 per cent.—a result which has now been successfully accomplished.

The lamps originally installed were of the ordinary Keith type, with an enamelled reflector and glass globe, having a central opening at the bottom and kept in position by wire clips. The effect was good. However, in a rubber factory with so much inflammable material about, insurance restrictions are severe and naked lights are banned. It was therefore desirable to adopt a method of lighting up, which, while not exposing a naked light, would also, through usage, not damage the mantles and glass. In view of the small consumption of the burners it was evident that a by-pass going continuously would consume in the course of the year practically as much as the burner. An electric torch was therefore devised somewhat on the lines of the "Telephos," consisting of a battery with a long igniter and push-button. This worked fairly well, but the cost was rather high and the igniter had to be held pretty close to the mantle to ensure lighting. In this way many mantles were broken.

These troubles, combined with the dusty atmosphere which prevails in many portions of a rubber factory, led the James Keith and Blackman Co., who had experienced the same difficulty in other places, to bring out what is termed the "Duct" system. In this system a special box conveying fresh air (free from the inside dust) from outside is led through the building, and the high pressure gas is coupled up at various points in its length, each of these connections supplying, by means of one injector, a number of high pressure burners.

One advantage of this arrangement is that the injector, being of large capacity, is not liable to get choked. The correct quantity of fresh air is drawn in from the duct, the mixture of gas and air being forced along a pipe $\frac{3}{4}$ in. or 1 in. in diameter, to which the burners are attached at suitable positions. The burners consist of a flexible down-tube to compensate for vibration, with a heating chamber at the foot, to which the nozzle is fixed on the lower side and on which, in turn, the mantle is screwed. Small square opal reflectors in four pieces are fitted immediately above this to throw the light down on the tables or machines. No globe of any kind is

required, but a small round wire gauze is hung about two inches below the mantle so as to intercept any ash or mantle-rings, should they fall.

The chief advantages of the system are that, owing to the capacity of injectors and absence of nipples or air-adjustment, chokage through dust is obviated; in the case of dust-laden atmospheres, fresh air can be led in from outside the building while, in ordinary factories, the duct can be connected to the air supply inside the room. No globes are required, which should lead to a saving in maintenance. The consumption can be brought down to one cubic foot per hour or even less; this should enable relatively small high pressure lights of low candle-power to be easily obtained.

It was also mentioned that Mr. Keith had been experimenting for some time in the direction of obtaining a thoroughly reliable lighter which would meet the requirements of insurance companies, and that he had now evolved a satisfactory arrangement.

A SUPER-EFFICIENCY CARBON FILAMENT LAMP.

Under the above title the *Electrical World* describes a new patent of the Siemens and Halske Co., of Berlin. This describes a proposed form of carbon filament lamp credited with a specific consumption even less than that of the so-called "half-watt" lamp. The inventors' names are given as H. Kreusler, H. Gerdien, and M. v. Pirani.

The lamp appears to be a return to the oft-exploited idea of enclosing carbon filaments in an atmosphere of mercury vapour. Within the outer bulb, which has a long neck somewhat similar to that used in half-watt bulbs, there is a cylindrical chamber filled with nitrogen, argon, or other insert gas. The filament is in the form of a stout spiral, and is situated close to the bottom of the bulb. Below it is a small amount of mercury. As soon as the filament is heated by the passage of the current the tube becomes filled with mercury vapour and the inert gas is partly driven out through the top of the inner tube into the surrounding envelope.

The outer tube glass surface remains relatively cool and is thus able to withstand the comparatively high internal pressure, which is above atmospheric.

A NEW NOTE IN STREET LIGHTING.

According to the *Electrical World* a new note is being struck in the street lighting at San Francisco, where some of the experience gained in the exhibition last year is evidently being applied. An attempt is being made to aim at something more decorative than the average street lighting.

The three main characteristics of the new lighting are as follows:—

(1) The colour-tone is a golden glow instead of the somewhat hard white usual in American cities, the colour being obtained by special tinted globes.

(2) Free use is made of arcs in groups instead of single units, those groups being placed at an exceptional height so as to diminish glare and improve the distribution of illumination. The overall length of the new decorative standards is given as 32 ft.

(3) Street Railway Poles have been mainly utilised, thus reducing the number of standards in the streets.

In some parts of the city standards carrying a combination of arcs and incandescent gas-filled lamps are utilised, the colour of the globes used for the latter being selected so as to match the light of the arcs.

COGS IN THE INDUSTRIAL WHEEL: WELFARE WORK AND WHAT IT MEANS.

By Mrs. M. A. Cloudesley Brereton, M.R.San.I., F.I.H., &c.

One of the chief causes of industrial unrest, as indeed of most human ills, has been the tendency of the mass of mankind to think in terms of "rights" rather than of "responsibilities." The individual is apt to lose sight of his own duties towards others in the emphasis laid upon his duties towards himself and those of others towards him. In industrialism this tendency is constantly making itself felt, and not least in that modern development of the doctrine of responsibility which is known as "welfare or social work."

A Notable Book.

Now welfare work, to give it its generally recognised title, is no new thing, no mere war-time expedient; it was known in the land before the passing of the Factory Acts. Defined as "voluntary efforts on the part of employers to improve, within the existing industrial system, the conditions of employment in their own factories," we can note its workings in the early years of the Nineteenth Century, and it would be idle to deny, in the face of evidence brought together in the volume entitled *Welfare Work*,* that the manufacturers themselves played a considerable part in the movement for factory legislation. This book is the work of Miss Dorothea Proud, a graduate of the University of Adelaide, who brought to her task the fruit of many years of patient inquiry and research into the conditions of welfare work as carried on in the factories of the Commonwealth and of Great Britain, and is now serving in the Welfare Department of the Ministry of Munitions, under the direction of Mr. B. S. Rowntree. Miss Proud's very valuable and illuminating book is prefaced by a foreword from the pen of Mr. Lloyd George, who speaks with the greatest enthusiasm of the work undertaken by this Department since its inception, and prophesies that welfare work as practised in the munition factories of to-day will in happier times of peace become one of the most important cogs in the industrial wheel. "It is a strange irony," he says, "but no small compensation, that the making of weapons of destruction should afford the occasion to humanise industry. Yet such is the case. Old prejudices have vanished, new ideas are abroad; employers and workers, the public and the State, are all favourable to new methods. The opportunity must not be allowed to slip. It may well be that, when the tumult of war is a distant echo, and the making of munitions a nightmare of the past, the effort now being made to soften asperities, to secure the welfare of the workers, and to build a bridge of sympathy and understanding between employer and employed, will have left behind results of permanent and enduring value, to the workers, to the nation, and to mankind at large."

Philanthropy or Profit?

We read in Miss Proud's book of employers of an earlier day who endeavoured to keep secret their enlightened treatment of their workpeople in order to protect other employers less fortunately placed; we read also of others who demanded legislation as a means of bringing tyrannical or callous employers into line with their own greater humanity. Here we see the ever-present conflict between rights and responsibilities, as we see it in the suspicious attitude towards "welfare work" that persists even to-day among not a few workers. They so little understand the meaning of responsibility that any concession on the part of their employer seems to them a mask

* A notice of this book appears on p. 290.—Ed.

for some act of aggression—the preliminary, say, to a reduction of wages or an increase of hours. To the open-minded, however, welfare work in its truest sense implies a condition of strict justice: the employer realises what he owes to his hands in the way of decent treatment, but expects in return his fair measure of honest work from them and penalises those who come short in this respect, the workman feels that just as he has a right to healthy and decent conditions so too his master has a right to the best work that these conditions make possible.

Thus all fear of the much-hated "philanthropy" or "charity" is eliminated from the relationship of employer and employed. It is of course undoubted that pity forms a strong element in the modern tendency of employers to reproduce as far as is possible the personal intercourse and almost paternal care which used to be the basis of the contact between master and man; but there is another potent force to be considered, the hope of profit. This motive, in Miss Proud's experience, is the only one tolerated in America, but in this country neither pure business nor pure philanthropy is the chief spur to action. No doubt the opinion is gradually gaining ground that, as W. T. Layton puts it in *Capital and Labour*, "'Welfare work' is not only a means of satisfying the humanitarian instincts of employers, but is also a commercially successful device for improving the efficiency of business. . . . The evidence on the whole goes to prove that there is a distinct monetary gain both to employers and employed from wholesome conditions in the factory and from attention to the physical fitness of the operatives": testimony is, for instance, repeatedly given as to the fact that shorter hours generally mean increased output. The keynote, however, of the whole welfare movement is the recognition of personality. In Miss Proud's words, "Industry has, at least to some extent, passed through the phase in which a group of workers was looked upon as a mere multiple of a single worker. It is recognised that its members have duties, rights, and desires, as a group and as individuals. To adjust these is a task too delicate to be left to spare moments or the chance interest of the employer. It is gradually becoming recognised as the business of an expert, though it must not be forgotten that the one indispensable quality for its successful accomplishment is tact."

No Sinecure.

Obviously something more than a degree in economics or social science is necessary for an official who is to stand between employer and employed and to interpret the one to the other with perfect freedom and fairness. Unflagging energy as well as wide sympathies are essential, for the welfare work in a large factory is no sinecure, and the path, as of everyone who in any sense of the words tries to serve two masters, is beset with pitfalls. The responsibility, too, is great. The welfare secretary exercises a general supervision over the wages and hours of the workers, their instruction, their health, their recreation, and their savings: he or she is answerable for the discipline of the factory, and for the considerate treatment of the workers. The various ramifications of these duties, and the kind of work entailed by their proper carrying out, I have not space to describe in this article: he who runs may read of it in Miss Proud's book, where the scope of the Welfare Department in any factory is described in the fullest and most interesting detail.

The Maligned Employer.

The chief impression, to my mind, that remains with one after reading the book is surprise at what has already been done, quietly and without undue publicity, by so many employers of labour large and small. It is not so very long, as years go, since the Industrial Revolution, but we have travelled far in those years, and all along the line we see employers, representatives of the hated class from which no good could come, performing the functions of pioneers of progress, despite the obstacles set in their path alike by friends—their compeers, and "foes"—their employees. The stony-hearted "villain of the piece" has been rather the consumer, ignorant of the suffering involved in unrestricted labour, than the employer with the misery always

before his eyes. But, with the swamping of the personal relation by force of numbers, the problem becomes even greater for the modern manufacturer, and the man who will lay the industrial world at his feet by solving the difficulties existing between capital and labour is still to be. Meanwhile, to my way of thinking, welfare work properly organised and carried on by a responsible person in such a way that it benefits employer and employed alike, seems to constitute a decided step in the right direction: and with that conclusion everyone who reads Miss Proud's book must, I feel sure, agree.

REVIEWS OF BOOKS.

Welfare Work, by E. Dorothea Proud, B.A., with a foreword by the Rt. Hon. David Lloyd George. (*Messrs. G. Bell and Sons, Ltd., London*, 1916, 363 *pp.*)

THE book by Miss Proud, referred to in the article by Mrs. Cloudesley Brereton in the preceding pages, is divided into two parts, the former dealing with the principles underlying welfare work in factories and the historical treatment of past work; the latter mainly with administrative details.

The first two chapters analyse the function of the employer in a capitalistic state, and his influence on factory legislation. Following this we have a summary of the trend of industrial legislation as a whole and a sketch of the gradually changing view held by employers on this subject. One drawback, however, to the present development of large companies and big industrial concerns is that the employer tends to lose touch with his men, and it is largely this fact that has necessitated the formation of "welfare departments" to act as a go-between and see that the social and hygienic needs of workers are not overlooked. Gradually the idea is taking shape that such work is not "charity" nor a concession to workers, but a wise mutual arrangement profitable alike to employer and employee.

In Part II. the scope of the Welfare Movement is discussed in detail. We are shown how the industrial environment, the provision of lavatories and cloak rooms, mess rooms, rest rooms, &c., should be studied; and how the physical well-being of workers can be promoted by attention to food, recreation, housing, education, &c.

Finally, there are an appendix in which a considerable amount of varied matter bearing on industrial welfare is assembled, and an adequate index.

A feature of the book is the very full series of references to earlier work which should make it invaluable to students in this field.

We hope that, in a future edition, the author will see fit to devote a special section to *illumination*, which is now regarded as a most important element in the health and efficiency of workers.

Optical Glass, by Walter Rosenhain, D.Sc., F.R.S. (*Cantor Lectures delivered before the Royal Society of Arts on November 29th, December 6th and 13th*, 1915.)

SINCE the outbreak of war few subjects have been more constantly debated in scientific circles than our deficiencies in the manufacture of optical glass. Dr. Rosenhain's Cantor Lectures on this subject, now published in pamphlet form, are therefore most opportune.

In his first lecture he explains the fundamental properties which distinguish "optical" from ordinary glass, empha-

sising the need for refinement in the making of colourless media, having a minimum absorption of light. It is important to notice that some forms of "neutral glass" are only obtained by arranging for the respective undue absorption of the pink and green elements in the spectrum to "cancel out," thus securing the neutral quality by undue absorption of light. In an ideal glass neutrality would be secured by correctly transmitting the entire spectrum with no loss of light. Other qualities desirable in optical glass are (1) absence of gas-bubbles and freedom from inequality in structure through the formation of small local crystals, which cause *striæ*. All these qualities require to be tested with minute care.

Of equal importance is the durability of the glass. Some kinds of glass, especially those containing much alkali, are unable to resist the chemical effect of the atmosphere, the surface being readily deteriorated by moisture and carbon dioxide. In practice one must make a compromise between durability and other necessary qualities.

The building up of the optical glass industry in Germany dates from the State-aided researches of Schott and Abbe, at Jena. Germany has also been helped by the fact of there being available sources of very pure sand. We have hitherto been dependent mainly on the sand imported from Fontainebleau, near Paris. A systematic search of the British Dominions might, however, reveal other sources of this material.

Dr. Rosenhain also deals with the various furnaces available for glass work, both gas-, electric-, and coal-heated, and with the process of turning out furnace-pots of good quality.

A question of great theoretical interest is the synthetic building up of materials such as occur in various transparent crystals; possibly in this way qualities hitherto unobtainable in glass, as at present manufactured, might be discovered. It is worth noting that the essential principles employed in the manufacture of optical glass at Jena were known many years ago; no radical departures have been made. There is no inherent reason why optical glass should not be made as well in this country as in Germany. The conditions which enabled that country to take the lead are well understood, but by adequately supported scientific research, and by striking out in new directions and not merely following the lines they have adopted, the whole industry might be placed on a better basis; if this were done the author sees no need for tariffs or subsidies.

But it is to be observed that Dr. Rosenhain questions whether the mere manufacture of optical glass is—even at the present time—commercially profitable. Its real value lies in its possible applications to many vital dependent processes, and in this sense it may fitly be described as a "key-industry" of considerable practical importance

The Theory of the Flicker Photometer, by H. E. Ives and E. F. Kingsbury. (Phil. Mag., Vol. XXXI., April, 1916.)

THIS paper is subsidiary to the authors' previous contribution to the *Philosophical Magazine* in 1914. The study of the connection between critical speed and illumination is continued, and the relation connecting these quantities is deduced, namely:—

$$\text{critical speed} = a \log \text{illumination} + b.$$

The high sensibility attributed by the author to the flicker photometer is ascribed to the very rapid increase in the critical frequency of disappearance of flicker on each side of the equality setting. Curves are presented showing this connection. These curves are shown meeting in a cusp at a point on the abscissa, though in practice experience shows that the curves are somewhat rounded at this point; this is presumably due to imperfections in the line of division between the photometric surfaces. It is also stated that imperfections in the flicker surface shift the equality point appreciably, so that such photometers should always be used on the "substitution" or "double-weighing" method.

When one turns to the use of the flicker photometer for lights which differ in colour one finds that the point of balance is affected by various alterations in design. For example, if the period of exposure for the two colours is unequal, that exposed for the shorter time will be under-rated. Even for lights of the same colour the point of balance may be shifted by unequal exposure if the surface of the rotating disc is not optically uniform.

General Electric Review, U.S.A. (September, 1916).

THE *General Electric Review* for September contains several articles on illumination. M. Luckiesh, in "THE FUNDAMENTALS OF LIGHTING," emphasises the part played by colour and light

and shade in connection with architectural and decorative effects. One point of interest is the relation between the actual variations in brightness and those which may be distinguished by the eye. The adaptation of the eye plays a great part. Thus the variations perceptible out of doors at night may be as much as 10 per cent., whereas, under ideal conditions indoors, a variation of less than 2 per cent. can be detected. In determining the permissible variation in illumination this fact should be borne in mind.

A. L. Powell contributes an illustrated article on "INTERIOR ILLUMINATION," in which a number of specific problems, for example, the lighting of armouries and gymnasiums, show-windows, stores, churches, tennis courts, etc., are discussed.

H. H. Reeves, in "INCANDESCENT STREET LIGHTING REGULATING APPARATUS," weighs the advantages and drawbacks of various types of regulators for constant current circuits.

W. S. Andrews has an interesting note on "SELF-LUMINOUS PAINTS." A most important question is the percentage of radio-active substance which it is desirable to mix with the luminescing sulphide. In general, a higher percentage of the radium element means a greater initial brightness but a shorter life. It is interesting to note that for Army and Navy purposes the United States Government calls for a guarantee of an undiminished luminosity for two years—a requirement that can be met without difficulty.

Reference is also made to other possible sources of radio-activity, such as radiothorium. This has a very intense effect, but its "half-life" is only three to four years. Mesothorium, a by-product of the mantle industry, is now being used on account of its comparative cheapness. There is a difference in opinion as to the relative merits of paint using respectively radium and mesothorium, but both will probably find their appropriate applications in the future.

Publications of the Bureau of Standards (Washington).

THE work of the Bureau of Standards (Washington) affords an excellent example of what can be done by a well-equipped experimental station. The Bulletins cover an exceedingly wide ground, and their free distribution in other countries is an international service. The publicity arrangements are worthy of special commendation, an abstract being furnished with each bulletin so that its contents can be understood at a glance and the chief points appreciated. The work of the Bureau of Standards is of public benefit, and the distribution of information published by it appears to be carried out on a well-organised plan. Accompanying the abstract is a note to the effect that copies of any bulletin will be sent free to any one applying for it, and an effort is made to see that each publication reaches people to whom it will be of value. After so much has been spent on the organisation and equipment of an experimental institution of this kind, the additional expenditure needed to make its work well known and widely recognised appears fully justified. This practice might with advantage be imitated by Government Departments in this country.

As an instance we have before us Bulletin No. 56 on *Standards for Electric Service*. This is a summary of the various steps being taken to promote uniformity of practice on the part of electricity concerns in America, both as regards general local legislation, and such matters as adequacy and safety of electric service, meters and instruments, and standardising laboratories. The contents of the Bulletin occupy upwards of 250 pages, so that the three-page typed abstract provided is welcome. Many of the suggestions made should be of direct interest to electricity companies in this country.

Among other recent publications received from the Bureau of Standards, we note :—

No. 281. *A Study of the Inductance of Four-terminal Resistance Standards.*

No. 283. *Volume Effect in the Silver Voltameter.*

No. 284. *Constants of Spectral Radiation of a uniformly heated Inclosure or so-called Black Body.*

No. 286. *Determination of Aluminium as Oxide.*

THE LIGHTING OF A TENNIS COURT BY MERCURY VAPOUR LAMPS.

In past issues of this journal the Illumination of Covered Lawn Tennis Courts by tungsten lamps, and also by high pressure gas has been described. A somewhat different problem is the lighting of tennis courts, as exemplified by the court at the Prince's Tennis and Racquets Club in Knightsbridge, which has been illuminated by mercury vapour lamps.

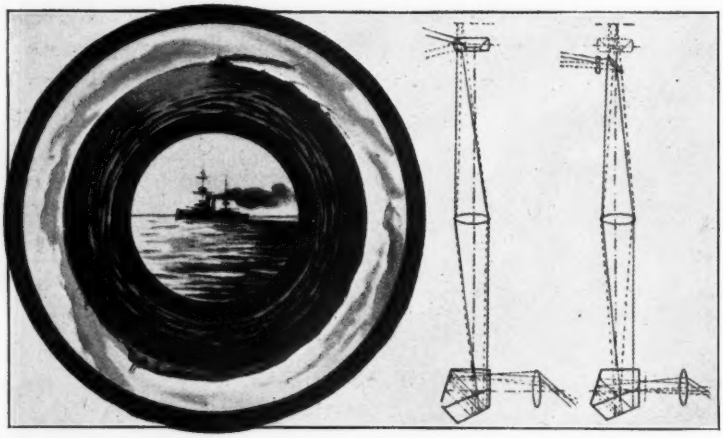
Tennis, as distinguished from lawn tennis, is a game that dates back hundreds of years. It is played under somewhat peculiar conditions in a specially constructed court, the floor and walls of which are composed mainly of smooth grey stone. During the daytime the illumination for the court is received from a large skylight occupying the greater part of the ceiling, and thus making it difficult for indirect methods to be used. The grey surroundings naturally render little assistance in diffusing the light, and it is therefore essential to use lamps in which the light is spread out over a large area.

The illustration will give an idea of the lighting of this court. Twenty mercury vapour lamps, each consuming 350 watts and rated at 1,000 c.p. were suspended from the girders at appropriate intervals. The court is approximately 80 feet long and 40 feet broad, so that the consumption works out to about 2·2 watts per square foot. A test of the illumination 3 feet above the floor showed that a fairly uniform value of 3·5–5 foot-candles is provided. In this game the ball travels rapidly round the court and is taken by the players as it bounces from the back walls. It is therefore essential that a person standing with his face to the wall should not cast a dense shadow. A feature claimed for this installation of mercury lamps is that the shadows are exceedingly soft, and no trouble from this source is experienced.

Illumination of Prince's Tennis Court, Knightsbridge, by mercury vapour lamps.

PANORAMIC PERISCOPE FOR SUBMARINES.

THE present war, with its long-range artillery, has emphasised the importance of scientific devices for observing the enemy at a distance. As is well known this faculty is particularly vital in the case of submarines, which observe the character of approaching vessels by means of a periscope, projecting above the surface of the water while the submarine remains submerged.



According to *Popular Mechanics*, in the modern periscope an arrangement is introduced, enabling both a general survey of the horizon and a detailed observation of any particular vessel to be made. This is described as follows :—

One of the great handicaps imposed upon the operators of modern submarines has been the inability to see in more than one direction at a time. Only by turning the periscope, or encircling a "walk round," has it been possible to scan the whole horizon, and then not at a single glance as now.

At the top of the instrument is an annular lens, the exterior of which has a spherical curvature while the interior is ellipsoidal. Images of everything discernible about the whole horizon are first refracted and then reflected down the tube. They are collected in a horizental plane by a condenser set midway in the tube, and thrown upon a five-sided prism at the bottom which reflects the rays twice and projects them through the binoculars. The view given the observer is circular ; much the same in appearance as if he were looking at one side of a globe.

This describes one-half of the instrument, which in reality is a double periscope. Immediately below the lens at the top of the tube is a second eye, and this may be turned in any direction and focused on a specific object, just as an ordinary periscope may. The rays entering it pass down the tube in the same manner as the others, but without interfering with them. The image appears in the centre of the panoramic picture and is greatly magnified in comparison with individual objects shown in the latter.

TOPICAL AND INDUSTRIAL SECTION.

[At the request of many of our readers we have extended the space devoted to this Section, and are open to receive for publication particulars of interesting installations, new developments in lamps, fixtures, and all kinds of apparatus connected with illumination.

The contents of these pages, in which is included information supplied by the makers, will, it is hoped, serve as a guide to recent commercial developments, and we welcome the receipt of all *bona-fide* information relating thereto.]

RAILWAY LIGHTING.

We have received from **Holophane Ltd.** a booklet describing the applications of Holophane units to various problems in railway lighting, such as the illumination of platforms, booking halls, offices, coaches, &c. The booklet is illustrated by photographs of installations on many of the London railways, and all the chief types of Holophane glassware are seen in operation. There are also some installation data and particulars of indoor and outdoor industrial units, adapted for half-watt lamps and particularly suitable for goods yards, sidings, &c.

MAZDA LAMPS.

A recent list issued by the **British Thomson-Houston Co., Ltd.,** gives particulars of the latest types of Mazda drawn wire lamps. In addition to the standard types, ordinary and gas-filled, for voltages of 100—130 and 200—255, 25-volt lamps ranging from 15—100 watts are mentioned as being particularly suitable for train-lighting, in country houses, and for use with auto-transformers. In addition, "candle," "mazdalite," and other special types are illustrated.

Supplementary sheets dealing with half-watt and battery and automobile lamps have also been issued.

EDISWAN ITEMS.

Among various articles described in booklets received from the **Edison and Swan Electric Co., Ltd.,** is the Ediswan "Esco" Buzzer, which, owing to its compactness, can replace an electric bell with advantage for many purposes. By means of a screw adjustment twelve distinct tones can be obtained.

Another pamphlet deals with the Ediswan "Hosgood" stoneware electric utensils, such as boiling jugs, shaving pots, sterilisers and food warmers, &c. The smaller vessels will take 1—2 pints of liquid, which can be raised to boiling heat in 3 to 10 minutes, according to the capacity.

An interesting item is the Ediswan "H_2O" cell, which is intended to fulfil the functions of the Leclanché, but is smaller and more compact. This cell only requires the addition of water for charging, and, it is stated, can be stored for any length of time and in any climate without deterioration. Other advantages claimed are that it is not liable to creeping or evaporation whilst in use, that its internatal resistance is low, and that it does not polarise in use so readily as wet batteries of the "Leclanché" type.

SHADES FOR SUBDUED INTERIOR LIGHTING.

The more stringent regulations recently issued for the diminution of private lighting make it necessary for the consumer to exercise his ingenuity in preventing light straying out into the street; the present conditions have probably led him to study lighting more closely than he ever did before.

Undoubtedly the most important requirement is substantial blinds, through which little, if any, light can penetrate. If good opaque blinds are used little interference with the usual system of lighting will be necessary. In any room where a good general illumination is essential—for example, a workroom with operations going on over the entire floor—this way of meeting the problem may be strongly recommended.

In any case there should be no chinks through which *direct* light can pass. But it is often possible, at least in inland towns where the lighting regulations are not so severe as on the coast, to retain the existing curtains, even though they allow a little diffused light to penetrate outwards, provided the lamps in the room are suitably screened. The consumer who already uses a well shaded system of lighting, with most of the light thrown downwards, is here at an advantage. With light green casement curtains acceptable conditions can usually be produced, provided no direct light from the source reaches the curtains. A Holophane reflector with a silk or paper shade superimposed over it answers the purpose very well.

In shop-windows lamps must be screened in directions facing the street, and in addition to this it is usually necessary to diminish even the light reflected from the goods. This should be done as far as possible by using fewer lamps or lamps of smaller candlepower, not by the clumsy and occasionally dangerous practice of surrounding them with crinkled coloured paper.

Several of the firms interested in lighting appliances have turned out cardboard shades, which serve as advertisements, and answer the purpose of screening the lamps from outside view. The illustration shows a typical shade of this kind supplied free by the British Thomson Houston Co., Ltd.

The shade is posted flat, and is made up of stout dark coloured card, with stencil cut-out lettering, backed by orange tinted paper. From the accompanying illustration it will be seen that the shade can be placed over any electric lamp without removing the latter, while if an ordinary fancy glass shade is used, the "Mazda" shade will go over it. To place the screen in position, the two wings are locked together around the holder, this movement causing the shade itself to assume a curved form, thus shutting off the direct light rays from about one-third of the circumference of the lamp. The wings are locked in the following manner. The right-hand wing is first inserted in the slit (A) provided in the

other wing, the hooked end of the wing (B) being then held in a second slit (C). In this way the wings are held rigidly and the shade cannot fall off, or open out accidentally. The lettering shows up with a warm tint by transmitted light, and while shutting off all direct light in front, permits of ample illumination behind. By daylight the wording is also clearly outlined by reflected light.

A BRITISH TRADE BANK.

A most important series of recommendations are made in the Report just issued by the Committee under the chairmanship of Lord Farintosh, dealing with national financial facilities for trade.

It is recommended that a "British Trade Bank" should be constituted under Royal Charter. The chief features of the proposed bank would be as follows:—

(1) It should have a capital of £10,000,000. The first issue should be from £2,500,000 to £5,000,000, upon which, in the first instance, only a small amount should be paid up, but which should all be called up within a reasonable time. A further issue should be made afterwards, if possible at a premium.

(2) It should not accept deposits at call or short notice.

(3) It should only open current accounts for parties who are proposing to make use of the overseas facilities which it would afford.

(4) It should have a foreign department, where special facilities might be afforded for dealing with bills in foreign currency.

(5) It should open a credit department for the issue of credits to parties at home and abroad.

(6) It should enter into banking agency arrangements with existing Colonial or British foreign banks wherever they could be concluded upon reasonable terms, and where such arrangements were made it should undertake not to set up for a specified period its own branches or agencies. It should have power to set up branches or agencies where no British-Foreign bank of importance exists.

(7) It should inaugurate an information bureau.

(8) It should endeavour not to interfere in any business for which existing banks and banking houses now provide facilities, and it should try to promote working transactions on joint account with other banks, and should invite other banks to submit to it new transactions, which, owing to length of time, magnitude, or other reasons, they are not prepared to undertake alone.

(9) Where desirable, it should co-operate with the merchant and manufacturer and possibly accept risks upon joint account.

(10) It should become a centre for syndicate operations, availing itself of the special knowledge which it will possess through its Information Bureau.

(11) It should receive Government assistance.

It is suggested that the Bank should be formed without delay in order to be in operation by the time the war is over, when many opportunities for exercising its functions will arise. It is expected to be particularly helpful in financing overseas contracts and in assisting the considerable number of educated young men, who, at the conclusion of the war, will desire to open up new commercial fields in foreign countries.

The proposed Information Bureau, or "Bureau d'Etudes," should also be of great service in collecting statistics and information of value to the leading industries of the country.

HALF-WATT LANTERNS AND FITTINGS.

In too many cases fittings intended originally for use with one or more ordinary tungsten lamps of low candlepower, have been converted for use with a single high candlepower half-watt lamp. As a rule such devices do not give good results. The half-watt lamp requires special treatment with a view to getting satisfactory distribution of light. Moreover, in view of the greater heat produced, many methods which answered satisfactorily under the old conditions are not advisable when gas-filled lamps are employed.

We notice that **Messrs. Crompton and Co., Ltd.,** are producing a series of specially designed half-watt lanterns and fittings, of which the type shown in the adjacent illustration is an example. Such undesirable features as the use of clamping screws on the rim of the globe, or rubber rings or perishable packing materials, have been avoided. The fitting is equipped with separate panes of fluted glass (muranese or other types can also be used), thus facilitating renewal of broken glass at a low cost. The structure of the fittings is such as to concentrate the light in a useful downward direction, and by using appropriate glass the high intrinsic brilliancy of the half-watt lamp can be reduced without serious loss of light.

The fitting shown is intended for lamps up to 1,500 watts. In cases when lamps are run on an alternating circuit a small transformer can be fitted into the lantern, and on installations where diminished lighting is at present necessary a second holder, carrying a lamp of comparatively low candlepower, can be supported below the larger one.

MANUFACTURE OF BENJAMIN REFLECTORS.

Under the title "A Question of Origin," **The Benjamin Electric, Ltd.,** have issued a neat booklet descriptive of the manufacture of Benjamin Reflectors and other accessories, as carried on at the works in Rosebery Avenue, E.C. The booklet is illustrated by photographs showing the various processes in operation, including the stamping out of reflector-shapes under the big double-action press, the enamelling, special work in the tinsmith's shop, &c.

It will be recalled that a description of these processes was given in our issue for June, 1916. The main object of the booklet is to demonstrate, by actual photographs, the production of Benjamin Reflectors and other specialities at the Company's Workshops in London.

INDEX, September, 1916.

LIGHTING OF HOTELS AND RESTAURANTS.

A recent addition to the Holophane series of booklets deals with various phases of lighting in hotels and restaurants. There are photographs of a variety of installations, ranging from a small bar to a large restaurant. Some particulars are also given of Reflector Bowls, "Residence" reflectors, and other appropriate units for this class of work. From time immemorial the light of the distant hostel have cheered the traveller. At present, in view of the prevailing darkness outside, cheerful indoor illumination is all the more welcome.

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TILLEY HIGH PRESSURE GAS METAL FURNACES.

While the interest of our readers in high pressure gas is centred mainly on lighting problems, it should not be forgotten that heating with high pressure gas is now playing an important part in many industrial operations, for example, in furnaces for metallurgical work. A very compact form is the Tilley Metal Furnace for melting lead, zinc, tin, antimony, etc. One advantage of gas-heated furnaces of this description is that the gas is readily controlled, and the temperature easily kept at the right value.

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CALORIFIC STANDARD FOR GAS.

In his recent address before the North British Association of Gas Managers, Mr. Masterton referred to the advisability of establishing a calorific standard for gas. A reduction in candlepower affects mainly consumers using flat-flame burners, who number only 15—20 per cent. (or less) of the total consumers. If a calorific standard is adopted permanently the bulk of the consumers would benefit, and it seems unfair to the majority to keep back a progressive movement merely because a small percentage of consumers would be adversely affected.

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BIRMINGHAM CHAMBER OF COMMERCE—£50,000 DEVELOPMENT SCHEME.

A scheme has been set on foot by the Birmingham Chamber of Commerce for the establishment of a "House of Commerce" to act as a centre for industrial development in Birmingham. In the future it is hoped to investigate such questions as Transport, Publicity, and Preparation of Statistical Data, European, Colonial and South American Trade. The proposed House of Commerce will form part of a development scheme, for which £50,000 is needed, to deal adequately with all these matters.

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EDUCATION NOTES.

THE POLYTECHNIC.

We have received from THE POLYTECHNIC (Regent Street, London) particulars of the COURSES IN ENGINEERING AND MECHANICAL SCIENCE, to be given during the winter session, 1916. Besides general mechanical engineering, such subjects as motor-car management and inspection, aero engineering, and power plant design are included.

In view of the growing recognition of the benefits of technical education, it is encouraging to see that such evening classes are being persevered with, even in the present difficult circumstances. There must be many men engaged in engineering occupations during the day time who could better themselves by acquiring such special knowledge in their leisure time, and in the future we do not doubt that they will reap the benefit of their foresight in this respect.

The classes commence on October 2nd, and enrolment may take place from the 25th—29th of September.

THE NORTHAMPTON INSTITUTE

We are glad to see that in spite of the disturbance caused by the war, the Northampton Institute is making a creditable effort to maintain their useful work. We note that the Evening Session starts on September 5th, and the Day Courses Entrance Examinations on September 26th—27th, the Session commencing on October 2nd.

The prospectus contains particulars of varied courses in engineering, such as Automobile Work, Aeronautics, Radio-Telegraphy, and Technical Optics, of which the Northampton Institute has made a special feature. In view of the urgent need for skilled workers in this glass industry we hope that this last course will be well patronised.

We notice that during the past year some useful additions to the plant in the Electrical and Mechanical Engineering Departments have been made.